

L Number	Hits	Search Text	DB	Time stamp
1	1345	vegetable adj fibers	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:08
2	28	(vegetable adj fibers) and fibrillated	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:08
3	3	((vegetable adj fibers) and fibrillated) and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:48
4	510	shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:10
5	4	shives and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:12
6	787	plant adj fibers	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:12
7	16	(plant adj fibers) and fibrillated	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:12
9	0	((plant adj fibers) and fibrillated) and aramid) and shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:13
8	2	((plant adj fibers) and fibrillated) and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:13
10	136	reinforcing and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:13
12	2	L11 and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:14
13	0	((reinforcing and (vegetable adj fibers)) and fibrillated) and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:14
11	5	(reinforcing and (vegetable adj fibers)) and fibrillated	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:15
14	714	processing adj fibers	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:15
15	1	(processing adj fibers) and shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:16
16	4	(vegetable adj fibers) and shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:16
17	365	tin adj sulfide	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:17

18	0	(tin adj sulfide) and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:17
19	3821	friction adj lining	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:17
20	0	(friction adj lining) and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:17
21	0	(friction adj lining) and shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:17
22	3	(friction adj lining) and (tin adj sulfide)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:18
23	41	gasket and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:19
25	0	((gasket and (vegetable adj fibers)) and fibrillated) and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:19
24	5	(gasket and (vegetable adj fibers)) and fibrillated	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:19
26	5	gasket and shives	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:22
27	0	(gasket and shives) and (vegetable adj fibers)	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:20
28	8	((("5290627") or ("5232779") or ("5494748") or ("4197223")).PN.	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:23
29	0	4197223.pn. and aramid	USPAT; US-PGPUB; EPO; JPO; DERWENT	2002/12/20 13:48

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## Solid lubricants with a tin sulphide and carbon base

Patent Number: ☐ US6303545  
Publication date: 2001-10-16  
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Applicant(s): CHEMETALL GMBH (US)  
Requested Patent: ☐ DE19815992  
Application Number: US20000673004 20001006  
Priority Number(s): DE19981015992 19980409; WO1999EP02426 19990409  
IPC Classification: C10M103/02; C10M103/04  
EC Classification: C01G19/00, C10M103/00, C10M103/06, F16D69/02  
Equivalents: ☐ EP1070109 (WO9952997), A1, JP2002511517T, PL343175, ☐ WO9952997

### Abstract

The invention relates to tin sulfide- and carbon-based solid lubricants and solid lubricant combinations, methods for the production thereof as well as their use in friction liner mixtures and friction liners such as brake or clutch liners

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## Claims

What is claimed is:

1. A method of producing a solid lubricant, comprising:  
forming a reaction mixture comprising metallic tin, sulfur and carbon;  
wherein the sulfur is present in the reaction mixture in an amount greater than a stoichiometric amount based on a formation of  $\text{SnS}_2$ , and wherein the carbon is present in the mixture in an amount of 0.5 wt % to 20 wt % of the mixture; and  
heating the mixture to a temperature of between 200 DEG C. to 1500 DEG C. to form a reaction product.
2. The method of claim 1 wherein the metallic tin is finely dispersed in the mixture.
3. The method of claim 1 wherein the sulfur is present in the mixture in an amount of up to 5% excess of a stoichiometric amount based on a formation of  $\text{SnS}_2$ .
4. The method of claim 1 wherein the carbon comprises graphite.
5. The method of claim 1 wherein the carbon is selected from the group consisting of a synthetic carbon and a carbon black.
6. The method of claim 1 wherein the carbon is present in the mixture in an amount of 2 wt % to 8 wt % of the mixture.
7. The method of claim 1 wherein the temperature is between 800 DEG C. and 1200 DEG C.
8. The method of claim 1 wherein the step of heating comprises heating for a period of between 0.1 hours to 6.0 hours.
9. The method of claim 8 wherein the step of heating is performed under an inert atmosphere.
10. The method of claim 1 wherein the reaction product predominantly comprises  $\text{SnS}_2$ .
11. The method of claim 1 further comprising cooling the reaction product and grinding the cooled reaction product to form a ground reaction product.
12. The method of claim 11 further comprising combining the ground reaction product with a friction liner mixture.
13. The method of claim 12 wherein the friction liner mixture is a brake liner mixture or a clutch liner mixture.
14. The method of claim 1 further comprising combining the reaction product with graphite, zinc sulfide, tin(II)-sulfide, sulfur, and a metal phosphate to produce a solid lubricant combination.
15. The method of claim 14 wherein the solid lubricant combination comprises the reaction product in an amount of between 2 wt % to 50 wt %, the graphite in an amount of between 2 wt % to 40 wt %, the zinc sulfide in an amount of between 2 wt % to 40 wt %, the tin(II)-sulfide in an amount of between 2 wt. % to 30 wt. %, the sulfur in an amount of between 1 wt. % to 5 wt. %, and the metal phosphate in an amount of between 2 wt. % to 40 wt. %.
16. The method of claim 15 wherein the metal phosphate is selected from the group consisting of aluminum phosphate, calcium phosphate, iron phosphate, magnesium phosphate, and zinc pyrophosphate.
17. A reaction mixture for the production of a solid lubricant, comprising:  
metallic tin, sulfur, and carbon;  
wherein the sulfur is present in the mixture in an amount greater than a stoichiometric amount based on a formation of  $\text{SnS}_2$ , and wherein the carbon is present in the mixture in an amount of 0.5 wt. % to 20 wt. % of the mixture; and  
wherein the reaction mixture forms a tin sulfide matrix predominantly comprising  $\text{SnS}_2$  when the mixture is

heated to a temperature of between 200 DEG C. to 1500 DEG C.

18. The mixture of claim 17 wherein the sulfur is present in the mixture in an amount of up to 5% excess of a stoichiometric amount based on a formation of  $\text{SnS}_2$ .

19. The mixture of claim 17 wherein the carbon is present in the mixture in an amount of 2 wt. % to 8 wt. % of the weight of the mixture.

20. The mixture of claim 17 wherein the carbon comprises graphite.

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